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TECHNICAL MANUSCRIPT 582

AN 8-DAY DEW RECORDER

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DEPARTMENT OF THE ARMY
Fort Detrick
Frederick, Maryland 21701

TECHNICAL MANUSCRIPT 582

AN 8-DAY DEW RECORDER

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PLANT SCIENCES LABORATORIES

Project 1B562602AD09

February 1970

ABSTRACT

The Taylor 24-hour dew meter was modified to provide automatic, unattended operation for 8-day periods. A brass adapter fitted to the spring-drive mechanism advanced the pencil-holding arm about 0.5 inch per day on the rotating 12-inch-diameter ground-glass plate. Development of a self-feeding indelible pencil eliminated malfunction because of lead failure during periods of heavy dew. The 8-day unit is less than 6 inches high, is rugged, and is not subject to damage from insects and small animals during field use. A comparison of the recording of dew periods by the Taylor and the 8-day meter showed good agreement.

AN 8-DAY DEW RECORDER*

Taylor** developed a dew meter consisting of a ground-glass disc that is rotated by a spring-drive mechanism in a horizontal plane at one revolution per 24 hours (Fig. 1B). The upper (ground) surface of the disc becomes wet when its temperature is at or below the dew point of the ambient air (dew formation). A stationary indelible pencil, which rests continuously in a writing position on the upper surface of the glass disc, leaves a permanent mark only when that surface is wet. By measuring the angle subtended by the arc traced by the indelible pencil and noting the position of the pencil at any point in time, the intervals of time when the disc was wet during any 24-hour period can be determined. Other meters have been developed, some of which were discussed by Wallin,*** but for us the Taylor meter has proved the most satisfactory for field use over many years.

A serious limitation of the original Taylor meter was the requirement for manual servicing approximately once every 24 hours. Theis and Calpouzos**** modified the Taylor device, using a spring-drive mechanism to rotate a ground-glass plate approximately one revolution per week and a different indelible pencil that could record for 1 week even during periods of heavy rainfall. The Theis-Calpouzos meter pencil trace was slightly less than 0.25 inch per hour on a 14-inch glass plate, and the Taylor meter trace was about 0.9 inch per hour on an 8-inch plate.

The instrument described in this paper is a further modification of the Taylor device; in fact, Taylor meters can be converted quickly and inexpensively to units similar to that described below.

The main shaft of a reliable spring-drive clock mechanism***** was fitted with a brass adapter that both supported the 12-inch-diameter ground-glass disc and extended through a 0.5-inch-diameter hole in the center of the disc to about 0.5 inch above the top surface of the disc (Fig. 2). Threads were cut in the adapter for a retaining nut to hold the glass disc friction-tight against the supporting flange. Immediately above the threaded portion, the adapter was turned down to 0.125-inch diameter for a distance of 0.25 inch. The adapter serves as a solid

* This report should not be used as a literature citation in material to be published in the open literature. Readers interested in referencing the information contained herein should contact the senior author to ascertain when and where it may appear in citable form.

** Taylor, Carlton F. 1956. A device for recording the duration of dew deposits. Plant Disease Rep. 40:1025-1028.

*** Wallin, Jack R. 1963. Dew, its significance and measurement in phytopathology. Phytopathology 53:1210-1216.

**** Theis, T.; Calpouzos, L. 1957. A seven-day instrument for recording periods of rainfall and dew. Phytopathology 47:746-747.

***** We used a 24-hour, 8-day clock mechanism procured from the Bristol Co., Waterbury, Conn., but any reliable and rugged drive would be satisfactory.

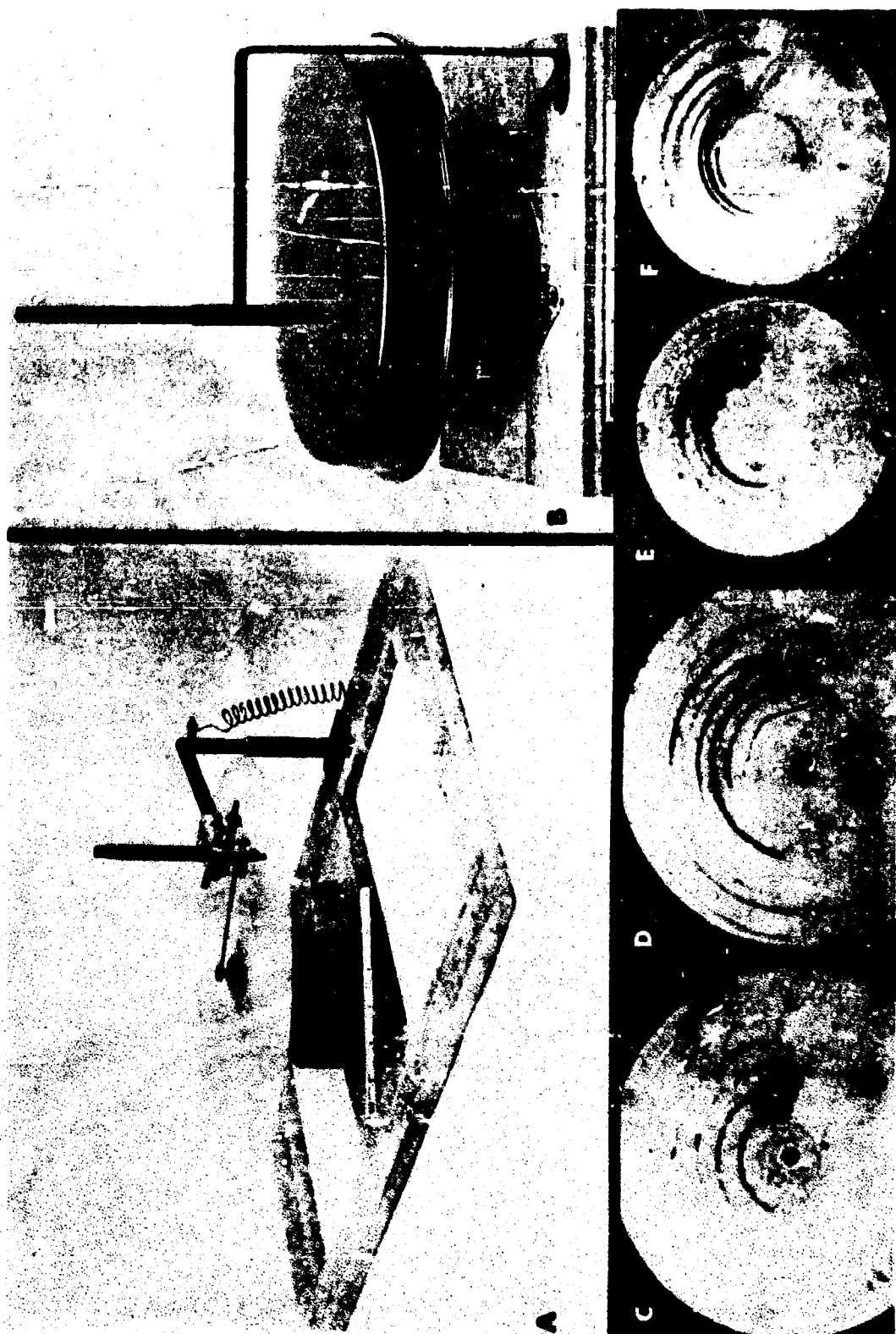


FIGURE 1. (A) Eight-Day Meter; (B) Present-Day Version of a Taylor Meter; Glass Plates Exposed on an 8-Day Meter for (C) a 6-Day Period and (D) a 7-Day Period; Plates Exposed on a Taylor Meter for (E) a 6-Day Period and (F) a 7-Day Period. The meters were oriented similarly in short grass within 4 feet of each other. The Taylor meter pencil was sharpened as necessary and moved manually to a new position daily.

extension of the main shaft when locked in place by the thumbscrew. The assembled unit (Fig. 1A) consists of the clock, adapter, and glass plate attached to an open, rectangular Plexiglas base. The pencil holder is attached to the end of a swinging arm that is mounted on the base. A thin, flexible wire connects the pencil holder to the turned-down portion of the adapter. As the ground-glass disc assembly rotates, the wire winches the pencil arm toward the plate center at about 0.5 inch per 24 hours; thus, each successive day's pencil trace is separated by 0.5 inch from the previous day's trace. The amount of separation is determined primarily by the diameter of the shaft to which the wire is attached. A smaller or larger separation requires only the appropriate diameter selection. A 12-inch-diameter glass disc with a 0.5-inch trace separation permits up to 8 days of continuous, unattended operation.

A weak spring attached to the writing arm provides back-tension to keep the wire between the arm and the central hub taut and prevent movement caused by wind gusts, etc.

Of the indelible pencils available to us for testing, the Eberhard Faber Mongol 844 was judged the most desirable for recording dew over a wide range of conditions in field studies. When sharpened and used in the conventional way, this pencil was not suitable for continuous, unattended operation for more than a few days under very wet conditions (dew, rain, or a combination of the two). An automatic pencil was devised in which 0.75-inch pieces of "lead" from the Mongol 844 pencil were stacked with a ball of No. 7 bird shot separating the pieces (Fig. 3). In use, the pencil tip is positioned about 0.25 inch above the glass plate surface, with the bottom piece of indelible lead resting on the plate. As the lead is used up, the bird shot drops to the plate and rolls away, permitting the next piece of indelible lead to drop into writing position. The bird shot separating the individual lead pieces minimizes the migration of moisture from the wet plate into the reserve lead pieces above (this happens under some conditions if a single, long lead piece is employed and can cause malfunction). The development of the automatic pencil eliminated the problem of lead failure during 7 to 8 days of continuous operation, while providing a readable trace under light or heavy dew conditions.

Because for many years the Taylor meter has provided our most reliable records of dew occurrence, it was compared under field conditions side-by-side with the 8-day meter. The Taylor meter was attended daily, and the 8-day meter was attended weekly. During a 2-month evaluation period, the two meters agreed fairly closely in their recording of dew periods, and the 8-day meter operated satisfactorily unattended for 7- to 8-day periods. The relationship of the Taylor dew record to actual dew occurrences on the foliage of interest will not be discussed here, except to state that we feel the meter, properly used, does provide valid and valuable information about the frequency and duration of periods when liquid moisture is on the plant foliage.

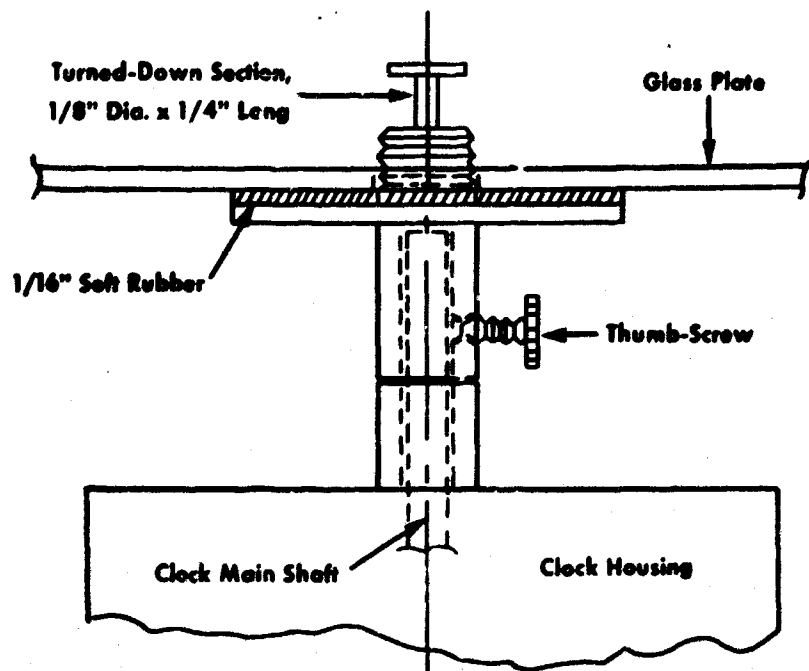


FIGURE 2. Diagram of Adapter. The adapter attaches to the main shaft of the clock mechanism and extends through a hole in the ground-glass plate.



FIGURE 3. Automatic Pencil Made from a Laboratory Ink Marker Pencil. (A) Assembled and ready for use. (B) Piece of indelible lead separated by No. 7 shot and weighted from above by a metal plug. (C) Metal sleeve to hold lead, shot, and weight. (D) Plastic exterior case of pencil.

A comparison of the 8-day meter with our present version of the Taylor meter for a 6-day and a 7-day period (Table 1) shows that differences between dew traces of as much as 1.75 hours on any given day did occur; however, differences of this magnitude have been noted on numerous occasions between traces from two Taylor meters operating within 4 to 6 feet of each other. Such variation may be caused by real differences in conditions at the two meters (positional effects), slight variations in the pencil lead, in the glass discs, etc.

TABLE 1. PERIODS OF WETNESS RECORDED BY THE 8-DAY METER
AND A TAYLOR (24-HOUR) DEW METER
LOCATED ABOUT 4 FEET APART IN SHORT GRASS

Day	Taylor Meter			8-Day Meter		
	Starting Time	Ending Time	Duration, hours	Starting Time	Ending Time	Duration, hours
1	0330	0800	4.5	0530	0930	4
2	2045	0915	12.5	2145	1030	12.75
3	2130	0915	11.75	2300	1000	11
4	2130	0945	12.25	2215	1000	11.75
5	2145	0945	12	0015	1030	10.25
6	2015	0945	13.5	2215	1000	11.75
1	2130	0900	11.5	2130	0815	10.75
2	-	-	0	-	-	0
3	2100	0930	12.5	2100	1000	13
4	2230	0715	8.75	2300	0800	9
5	0315	0800	4.75	0500	0830	3.5
6	2230	0930	11	0100	1030	9.5
7	2200	0930	11.5	2230	1100	12.5

The pencil trace, once dried on the glass plate, may be easily recognized even after 7 days' exposure to subsequent dews, rain, and sun (Fig. 1). The purple color may not remain after several successive wettings and dryings, but a white residue persists.

Using a 12-inch-diameter plate and a 0.5-inch increment between daily traces, the 8-day meter trace is about 1.3 inches per hour during the first day of operation and 0.7 inch per hour during the 7th day; even on the 7th day, the trace can be read accurately to 15-minute increments.

The 8-day meter, like the original Taylor meter, is low in overall height (<6 inches) and can be placed in the canopy of even low-growing vegetation. It is rugged, durable, and not subject to damage from insects and small animals. Fabrication and installation of the brass adapter (Fig. 2) and the automatic pencil (Fig. 3) on the Taylor meter to convert it to the 8-day meter should not cost more than \$10. Most of the expense of the unit is in the clock mechanism, which must be reliable and reasonably accurate. The cost of construction of an entire unit should be less than \$100.

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